Mr. Iſaac Newton's *Conſiderations upon part of a Letter of Monſieur de* Bercé *printed in the Eight French* Memoire, *concerning the Cata-drioptrical Teleſcope, pretended to be improv'd and refined by M.* Caſſegrain.

That the Reader may be enabled the better to Judge of the whole, by comparing together the contrivances both of Mr. Newton *and* Mr. Caſſegrain; *it will be neceſſary, to borrow from the ſaid French* Memoire *what is there ſaid concerning them: which is as followes.*

I Send you (ſaith M. de *Bercè* to the Publiſher of the *Memoire*,) the Copy of the Letter, which M. *Caſſagrain* hath written to me concerning the proportions of Sr. *Samuel Morelands* Trumpet. And as for the Teleſcope of Mr. *Newton* it hath as much ſurpriſed me, as the ſame Perſon, that hath found out the proportions of the Trumpet. For 'tis now about three months, that that perſon communicated to me the figure of a Teleſcope, which was almoſt like it, and which he had invented; but which I look upon as more witty. I ſhall here give you the deſcription of it in ſhort.

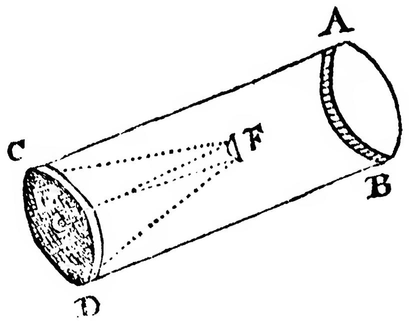
ABCD. is a ſtrong Tube, in the bottom of which there is a great concave *Speculum* CD, pierced in the midle E.

F. is a convex *Speculum*, ſo diſpoſed, as to its convexity, that it reflects the *Species*, which it receives from the great *Speculum*, towards the hole E, where is an Eye-glaſs, which one looketh through.

The advantage, which I find in this Inſtrument above that of Mr. *Newton*, is firſt, that the mouth or aperture AB of the Tube may be of what bigneſs you pleaſe; and conſequently you may have many more rays upon the Concave *Speculum*, than upon that, of which you have given us the deſcription. 2. The reflexion of the rays will be very natural, ſince it will be made upon the *axis* it ſelf, and therefore more vivid. 3. The viſion of it will be ſo much the more pleaſing, in that you ſhall not be incommoded by the great light, by reaſon of the bottom CD, which hideth the whole face. Beſides that

you'l

you'l have leſs difficulty in diſcovering the Objects, than in that of Mr. *Newtons*.



So far this French Author. To which we ſhall now ſubjoin the Conſiderations of Mr. Newton, *as we received them from him in a Letter, written from* Cambridge *May* 4th 1672, *as follows.*

SIR

I Should be very glad to meet with any improvement of the Catadioptrical Teleſcope; but that deſign of it, which (as you informe me) Mr. *Caſſegrain* hath communicated 3 months ſince, and is now printed in one of the French *Memoires*, I fear will not anſwer Expectation. For, when I firſt applied myſelf to try the effects of Reflexions, Mr. *Gregory's Optica Promota* (printed in the year 1663) being fallen into my hands, where there is an Inſtrument (deſcribed pag. 94) like that of Monſieur *Caſſegrain's* with a hole in the midſt of the Object-Metal to tranſmit the Light to an Eye-glaſs placed behind it; I had thence an occaſion of conſidering that ſort of conſtructions, and found their diſadvantages ſo great, that I ſaw it neceſſary, before I attempted any thing in the Practique, to alter the deſign of them, and place the Eye glaſs at the ſide of the Tube rather than at the midle.

The diſadvantages of it you will underſtand by theſe particulars. 1. There will be more light loſt in the Metal by reflexion from the little convex *ſpeculum*, than from the Oval plane. For, it is an obvious obſervation, that Light is moſt copiouſly reflected from any ſubſtance when incident moſt obliquely. 2 The convex *Speculum* will not reflect the rays ſo truly as the oval plane, unleſs it be of an Hyperbolique figure; which is incomparably more difficult to forme than a plane; and if truly formed, yet would only reflect thoſe rays truly, which reſpect the *axis*. 3 The errours of the ſaid convex will be much augmented by the too great diſtance, through which the rays, reflected from it, muſt paſs before their arrival at the Eye-glaſs. For which reaſon I find it convenient to make the Tube no wider than is neceſſary, that the Eye glaſs be placed as near to the Oval plane, as is poſſible, without obſtructing any uſeful light in its paſſage to the object metal. 4. The errors of the object-metal will be more augmented by reflexion from the convex than from the plane, becauſe of the inclination or deflexion of the convex on all ſides from the points, on which every ray ought to be incident. 5. For theſe reaſons there is requiſite an extraordinary exactneſs in the figure of the little convex, whereas I find by experience, that it is much more difficult to communicate an exact figure to ſuch ſmall pieces of Metal, than to thoſe that are greater. 6 Becauſe the errors at the perimeter of the concave Object-Metal, cauſed by the Sphericalneſs of its figure, are much augmented by the convex, it will not with diſtinctneſs bear ſo large an aperture, as in the other conſtruction. 7. By reaſon that the little convex conduces very much to the magnifying virtue of the inſtrument, which the Oval plane doth not, it will magnify much more in proportion to the Sphere, on which the great concave is ground, than in the other deſign; And ſo magnifying Objects much more than it ought to do in proportion to its aperture, it muſt repreſent them very obſcure and dark; and not only ſo, but alſo confuſed by reaſon of its being overcharged. Nor is there any convenient remedy for this. For, if the little convex be made of a larger Sphere, that will cauſe a greater inconvenience by intercepting too many of the beſt rayes; or, if the Charge of the Eye-glaſs be made ſo much ſhallower as is neceſſary, the angle of viſion will thereby become ſo little, that it will be very difficult and troubleſome to find an object, and of that object, when found, there will be but a very ſmall part ſeen at once.

By this you may perceive, that the three advantages, which Monſieur *Caſſegrain* propounds to himſelf, are rather diſadvantages. For, according to his deſign, the aperture of the inſtrument will be but ſmall, the object dark and confuſed, and alſo difficult to be found. Nor do I ſee, why the reflexion is more upon the ſame *axis*, and ſo more natural in one caſe than in the other: ſince the *axis* it ſelf is reflected towards the Eye by the Oval plain; and the Eye may be defended from external light as well at the ſide, as at the bottome of the Tube.

You ſee therefore, that the advantages of this deſign are none, but the diſadvantages ſo great and unavoidable, that I fear it will never be put in practiſe with good effect. And when I conſider, that by reaſon of its reſemblance with other Teleſcopes it is ſomething more obvious than the other conſtruction; I am apt to believe, that thoſe, who have attempted any thing in Catoptricks, have ever tryed it in the firſt place, and that their bad ſucceſs in that attempt hath been the cauſe, why nothing hath been done in reflexions. For, Mr. *Gregory*, ſpeaking of theſe inſtruments in the aforeſaid book pag 95, ſayeth; *De mechanica horum ſpeculorum & lentium, ab aliis fruſtrà tentatâ, ego in mechanicis minus verſatus nihil dico.* So that there have been tryals made of theſe Teleſcopes, but yet in vain. And I am informed, that about 7 or 8 years ſince, Mr. *Gregory* himſelf, at *London*, cauſed one of ſix foot to be made by Mr. *Reive*, which I take to have been according to the aforeſaid deſign deſcribed in his book; becauſe, though made by a skilful Artiſt, yet it was without ſucceſs.

I could wiſh therefore, Mr. *Caſſegrain* had tryed his deſign before he divulged it: But if, for further ſatisfaction, he pleaſe hereafter to try it, I believe the ſucceſs will inform him, that ſuch projects are of little moment till they be put in practiſe.

Some Experiments propos'd in relation to Mr. Newtons *Theory of light, printed in* Numb. 80; *together with the Obſervations made thereupon by the Author of that Theory; communicated in a Letter of his from* Cambridge, *April* 13. 1672.

I. TO contract the beams of the Sun without the hole of the window, and to place the priſm between the focus of the *Lens* and the hole, ſpoken of in M. *Newtons* theory of light,